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Impact of realistic soil moisture initialization on the representation of extreme events in the western Mediterranean

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In a warmer Mediterranean climate an increase in the intensity and frequency of extreme events like floods, droughts and extreme heat is expected. The ability to predict such events is still a great challenge and exhibits many uncertainties in the weather forecast and climate predictions. Thereby the missing knowledge about soil moisture-atmosphere interactions and their representation in models is identified as one of the main sources of uncertainty. In this context the soil moisture(SM) plays an important role in the partitioning of sensible and latent heat fluxes on the surface and consequently influences the boundary-layer stability and the precipitation formation.

The aim of this research work is to assess the influence of soil moisture-atmosphere interactions on the initiation and development of extreme events in the western Mediterranean (WMED). In this respect the impact of realistic SM initialization on the model representation of extreme events is investigated.

High-resolution simulations of different regions in the WMED, including various climate zones from moderate to arid climate, are conducted with the atmospheric COSMO (Consortium for Small-scale Modeling) model in the numerical weather prediction and climate mode. A multiscale temporal and spatial approach is used (days to years, ∼7km to 2.8km grid spacing). Observational data provided by the framework of the HYdrological cycle in the Mediterranean EXperiment (HyMeX) as well as satellite data such as precipitation from CMORPH (CPC MORPHing technique), evapotranspiration from Land Surface Analysis Satellite Applications Facility (LSA-SAF) and atmospheric moisture from MODIS (Moderate Resolution Imaging Spectroradiometer) are used for process understanding and model validation.
To select extreme dry and wet periods the Effective Drought Index (EDI) is calculated. In these periods sensitivity studies of extreme SM initialization scenarios are performed to prove a possible impact of soil moisture on precipitation in the WMED. For the realistic SM initialization different state-of-art high-resolution SM products (25km up to 1km grid spacing) of the Soil Moisture Ocean Salinity mission (SMOS) are examined. A CDF-matching method is applied to reduce the bias between model and SMOS-satellite observation. Moreover, techniques to estimate the initial soil moisture profile from satellite data are tested.